**CLAIMS**:

1. A sensor for measuring the water content of bulk materials comprising:

first and second elongate members, each having substantially identical shape and size so that the first and second members mate with one another and are bonded together to form a sensor;

sensor electronics mounted on the first member, the sensor electronics being protected by a housing, the sensor electronics being responsive to a direct current excitation for providing an output signal which is proportional to an amount of water present in a bulk material.

2. The sensor as recited in claim 1 wherein the sensor electronics comprise:

an oscillator responsive to a direct current excitation, to provide a square wave signal;

a transmission line being coupled to receive the square wave voltage signal from the oscillator through a resistor, and a phase detector to detect a difference in phase between the square wave voltage signal provided by the oscillator and the signal provided to the transmission line, the phase detector being further constructed to provide an output signal indicative of the difference in phase between a square wave signal provided to the transmission line through the resistor and the response of the transmission line.

3. The sensor as recited in claim 2 wherein the output of the sensor electronics is proportional to a water content of the bulk material.

4. The sensor as recited in claim 2 wherein the phase detector comprises:

a semiconductor circuit having first and second inputs and an output, the output of the semiconductor circuit being indicative of the phase difference of the signals applied to the first and second inputs of the semiconductor circuit, the first input of the semiconductor circuit being coupled to the oscillator to receive the square wave voltage signal and the second input of the semiconductor circuit coupled to the transmission line;

a resistor and a capacitor providing a low pass filter connected to the output of the semiconductor circuit producing a D.C. voltage proportional to the phase difference of the signals provided to the inputs.

5. The sensor as recited in claim 1 where the dielectric constant of a bulk medium is sensed using a transmission line embedded in the bulk material;

the transmission line comprising traces on an elongated printed circuit board, the circuit board further comprising a semiconductor circuit.

6. A sensor for measuring water content of bulk materials, the sensor being powered by a direct current excitation, the sensor comprising:

an oscillator to provide a square wave voltage signal;

a transmission line having an input and an output, the transmission line input being coupled to receive the square wave voltage signal, the transmission line output being coupled to a phase detector;

a phase detector to detect a phase difference between the square wave voltage signal provided by the oscillator and the signal provided to the transmission line, the phase detector providing an output signal indicative of the phase difference caused by changes in moisture content of a medium surrounding the transmission line.

7. The sensor as recited in claim 6 wherein the phase detector comprises:

a semiconductor circuit having first and second inputs and an output, the output of the semiconductor circuit being indicative of a logical exclusive OR function of signals applied to the first and second inputs of the semiconductor circuit, the first input of the semiconductor circuit being coupled to the oscillator to receive the square wave voltage signal and the second input of the semiconductor circuit being coupled to the transmission line;

a low pass filter providing a direct current output proportional to moisture content.

8. A sensor for measuring the water content of a bulk material comprising:

first and second semiconductor circuits forming an astable multivibrator oscillator, a third semiconductor circuit buffering the output of the oscillator, a first resistor driving a transmission line, a reference square wave provided to a fourth semiconductor circuit having first and second inputs and an output, the output of the fourth semiconductor circuit being indicative of a phase difference function of signals applied to the first and second inputs of the fourth semiconductor circuit, the first input of the fourth semiconductor circuit being coupled to the resistor driving the transmission line, the second input of the fourth semiconductor circuit being coupled to the output of the third semiconductor circuit, the transmission line input being coupled to the first input of the fourth semiconductor circuit;

a low pass filter comprising a second resistor and a capacitor to smooth the output of the fourth semiconductor to provide a direct current output proportional to a water content of the material surrounding the transmission line.